nanoimprinting in which resins or inorganic materials are pressure molded, and the electrodes and DNA chips for converting, producing or detecting the materials by an electrochemical reaction.

While the present invention has been described in conjunction with the embodiments thereof, it will be apparent to those skilled in the art that various changes and modifications can be made within the sprit and the scope defined by the appended claims of the present invention.

In reference to the present invention, the following details are disclosed.

(1) A fine metal structure having its surface furnished with microprojections, characterized in that the microprojections have a thickness or equivalent diameter ranging from 10 nanometers to 10 micrometers, and that the ratio of the equivalent diameter (D) to the height (H) of said microprojetions , H/D, is greater than 1.

(2) The fine metal structure according to (1) wherein the microprojections contain a nonmetallic element as an accessory constituent.

(3) The fine metal structure according to (2) wherein the nonmetallic element is boron.

(4) The fine metal structure according to (2) wherein at least part of the surface of each microprojection is coated with at least one layer of coating.

(5) The fine metal structure according to (2) wherein at least one organic material selected from the group consisting of antigens, antibodies, proteins, bases, sugar chains and surface modifiers is fixed directly or indirectly to the surface of each microprojection.

(6) A fine metal structure having its surface furnished with microprojections, characterized in that a molecular electroless plating catalyst is applied to the surface of a substrate having a fine rugged pattern, then electroless plating is carried out thereon to form a metal layer, and this metal layer is detached from the substrate to thereby effect reversal transfer of the rugged pattern.

(7) The fine metal structure according to (6) having microprojections whose thickness or equivalent diameter is from 10 nanometers to 10 micrometers.

(8) The fine metal structure according to (7) wherein the ratio of the equivalent diameter (D) of the microprojections to their height (H), H/D, is greater than 1.

(9) The fine metal structure according to (7) wherein the microprojections are made of an alloy containing a nonmetallic element as an accessory constituent.

(10) The fine metal structure according to (7) wherein at least part of the surface of each microprojection is coated with at least one layer of

coating.

(11) The fine metal structure according to (7) wherein at least one organic material selected from the group consisting of antigens, antibodies, proteins, bases, sugar chains and surface modifiers is fixed directly or indirectly to the surface of each microprojection.

(12) A fine metal structure having its surface furnished with microprojections, characterized in that at least part of the surface of each microprojection is coated with at least one layer of coating having a different composition from that of the microprojections.

(13) The fine metal structure according to (12) having a portion where the thickness or equivalent diameter of the microprojections is 10 nanometers to 10 micrometers.

(14) The fine metal structure according to (12) wherein the ratio of the equivalent diameter (D) of the microprojections to their height (H), H/D, is greater than 1.

(15) The fine metal structure according to (12) wherein the microprojections are made of an alloy containing a nonmetallic element as an accessory constituent.

(16) The fine metal structure according to (12) wherein at least one organic material selected from the group consisting of antigens, antibodies, proteins,

bases, sugar chains and surface modifiers is fixed to the surface of the coating layer.

(17) The fine metal structure according to (12) wherein the material composing the coating layer is gold.

(18) A process for producing a fine metal structure, which comprises providing a substrate having a fine rugged pattern on its surface, applying a molecular electroless plating catalyst to the substrate surface, thereafter carrying out electroless plating to form a metal layer having the rugged pattern filled, and detaching the metal layer from the substrate to thereby obtain a fine metal structure furnished with a surface having undergone reversal transfer of the rugged pattern.

(19) A process for producing a fine metal structure characterized in that after producing a fine metal structure according to the process of (18), at least one layer of coating having a different composition from that of said fine metal structure is formed on the surface of said fine metal structure.

(20) A process for producing a fine metal structure characterized in that after producing a fine metal structure according to the process of (18), at least one organic material selected from the group consisting of antigens, antibodies, proteins, bases, sugar chains and surface modifiers is fixed at least at a part of said gold coating surface.

(21) The process according to (18) wherein the rugged surface configuration of said fine structure is at least partly constituted by cylindrical microprojections, with the diameter or the length of one side thereof being 10 nanometers to 10 micrometers, and the ratio of the diameter or length of one side (D) to the height (H) of the microprojections, H/D, is greater than 1.

(22) A metal mold used for pressure molding of resins and inorganic materials, characterized in that the surface of the mold is constituted by the fine metal structure set forth in (1).

(23) A nanoimprinter in which resins or inorganic materials are pressure molded by using a fine metal mold, characterized in that the surface of said fine metal mold is constituted by the fine metal structure set forth in (1).

(24) An electrode for converting, producing or detecting the materials by an electrochemical reaction, characterized in that at least part of the surface of the electrode is constituted by the fine metal structure set forth in (1).

(25) A microchip having a fine ruggedness at the specimen detecting section, characterized in that the fine metal structure set forth in (1) is used for the detecting section.

(26) A microchip in which a material interacting with the specimen is fixed to the surface of a

substrate, characterized in that the fine metal structure set forth in (1) is used as said substrate.

(27) A DNA chip having many types of DNA fixed to the substrate surface, characterized in that the fine metal structure set forth in (1) is used as the substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0095]

[Fig. 1]

Fig. 1 is a schematic illustration of the makeup of a fine metal structure having microprojections on the surface.

[Fig. 2]

Fig. 2 is a flow sheet for producing a fine metal structure having microprojections on the surface.

[Fig. 3]

Fig. 3 schematically illustrates the process of growth of plating with a catalyst serving as a datum point.

[Fig. 4]

Fig. 4 is a schematic illustration based on a scanning electron microphotograph of the surface of a fine metal structure.

[Fig. 5]

Fig. 5 is a flow sheet for producing a fine metal structure.

[Fig. 6]

Fig. 6 is a flow sheet for producing a high-sensitivity gold electrode.

[Fig. 7]

Fig. 7 is a schematic illustration of a stamper.

[Fig. 8]

Fig. 8(a) is an apparatus for forming a peel ply on the convex surface of the stamper, and Fig. 8(b) is an apparatus for transferring fine ruggedness of the stamper to a substrate.

[Fig. 9]

Figs. 9(a) and 9(b) are the enlarged views of the portions near the stamper surface in the apparatuses of Figs. 8(a) and 8(b), respectively.

[Fig. 10]

Fig. 10(a) is a schematic illustration of a DNA fixing substrate, and Fig. 10(b) is a schematic illustration showing the state of the DNA probes being fixed to the surface of a DNA fixing substrate.

[Fig. 11]

Fig. 11 is scattered plots showing the result of a hybridization experiment using a DNA fixing substrate having microprojections on the surface.

[Fig. 12]

Fig. 12 is scattered plots showing the result of a hybridization experiment using a DNA fixing substrate having a flat surface.